**Work Paper Abstract**

**Commercial Lighting**

**Revision # 0**

**California Technical Forum**

**WP Abstract Prepared by: Alina Zohrabian, PG&E TPS**

**LED Panels**

***Abstract***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| WP Abstract Tracking Log | | | | |
|  | **Date Issued** | **Due By** | **Version** | **Author**  **(last name)** |
| Circulated to TF Members |  |  |  |  |
| Cal TF summarizes comments |  |  |  |  |
| Abstract presented at Meeting; consensus decision-marking |  |  |  |  |
| Cal TF finalizes abstract; prepares comparison exhibit of non-consensus items |  |  |  |  |
| Abstract to TF Subcommittee |  |  |  |  |
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**Table 1.** Work Paper Abstract Snapshot

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| --- | --- | --- |
| Work Paper Abstract Snapshot | | |
| Item | **Details** | **Notes** |
| Measure name | LED Panels | For recessed & other mountings.  Cal TF may also want to consider workpapers for Linear Ambient Luminaires, the other major DLC application category. |
| Measure description | Install new LED Panel Fixture or Retrofit Kit in 1’x4’, 2’x4’ or 2’x2’ sizes. Must be DLC-listed for Ambient Lighting of Interior Commercial Spaces | <http://designlights.org/Content/QPL/ProductSubmit/CategorySpecifications>; categories 15, 16, 17, 31, 32, 33.  Linear Ambient Luminaires fall in categories 18 through 21 depending on lumen distribution. |
| Sector (Res/Non-Res) | Non-Res |  |
| Subsector (e.g. Ag) | Office, Retail, Government, High Tech |  |
| Program(s) | Commercial Deemed Lighting Catalog, Commercial Upstream Deemed incentives, 3rd Party Programs |  |
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# Measure Description

The LED Panel measures are for ambient lighting of interior non-residential spaces. The base case for replacement on burnout or new construction is a linear fluorescent fixture in the same size.

# Key Terms

LED Panel: a luminaire or a retrofit kit for interior spaces with a light-emitting diode source that provides direct illumination. LED Panels are most typically recessed-mounted, but may also be surface-mounted.

# Program Implementation Method

The LED Panel measures are intended for upstream, midstream, downstream and direct install program delivery. Residential sectors are excluded. LED Panel measures may be NC, ROB, or ER.

# Mixed Baseline

We assume a 100% fluorescent baseline for the LED Panel measures, given the low penetration of LED lighting and the assumption that existing LED luminaires are unlikely to be targeted for replacement. The DOE in May 2013 estimated LED penetration in the recessed market at less than 0.1%.[[1]](#endnote-1)

We think that the baseline is a mixture of 1st and 2nd generation T8s but the TF may want to consider these contributors to the baseline solution as well as the potential of using some T12s. Should we be claiming savings for equipment that does not meet current CA code, but which the owner is allowed to continue operating if no code-triggering lighting modification is pursued?

# Measure Summary

**Table 2.** Measure Summary

|  |  |
| --- | --- |
| **Characteristic** | **Measure** |
| Baseline Technology or Mix | Linear Fluorescent |
| Measure Technology | LED |
| Measure Application Type | ROB, NC, and ER |
| Delivery Mechanism | Upstream, Midstream, Downstream, and Direct Install |
| Impacted Markets | All Non-Residential; primarily commercial |
| Relevant Codes and Standards | T24, T20, federal lamp and ballast standards |

# Estimated Size of Offer (Number of Participants)

Market potential estimates are from the 2008 CASE Report on linear fluorescent fixtures, preliminary version.[[2]](#endnote-2) Page 12 of this report states:

“Based on 2005 ballast sales from the U.S. Census Bureau (2006), 83 million fluorescent ballasts are shipped each year nationwide and 72% are shipped to fixture manufacturers. Of the total ballasts shipped, 5 million of these (7%) are intended for use in the residential sector, not including imports (which are likely significant). We estimate that California represents 9.06% of this market, based on the percentage of national commercial floor area in the Pacific West census region (EIA, 2003) and the portion of the Pacific West population that resides in California (Census Bureau, 2002). For California’s share of residential fixture sales, we chose 10.9% based on population only. Assuming a 25-year life for most four-foot fluorescent fixtures, we derived existing stock estimates for commercial and residential fixtures, as shown in Table 7. By these assumptions we estimate that there are 5.1 million linear fluorescent fixtures sold each year in the California commercial building sector, excluding T5 fixtures, along with another 0.4 million fixtures sold in the residential market.”

The total number of linear fluorescent fixtures sold in PG&E territory for the commercial building sector can be calculated from this California statewide sales estimate of 5.1 million fixtures, by applying PG&E’s share of statewide electricity sales. According to the California Energy Commission’s (CEC’s) 2006 numbers, PG&E sold 31.8% of the kWh in California.***[[3]](#endnote-3)*** The resultant estimate of fluorescent fixtures sales sold annual in PG&E service territory is 1.6 million fixtures. At annual adoption rates of 5% (based on U.S. LED Adoption Forecast from DOE 2012 Report[[4]](#endnote-4)), LED Panel measures might see sales of 80,000 units in PG&E service territory.

# Estimated Impact of the Measure on Statewide Energy Efficiency Savings.

The DOE’s May 2013 study on Adoption of Light-Emitting Diodes in Common Lighting Applications found addressable potential LED Energy Savings in recessed applications nationwide of 110.4 TWh,[[5]](#endnote-5) which would correspond to 10 TWh statewide and 3.2 TWh in PG&E service territory. Even at 4% stock turnover annually, this market could generate savings of 120 GWh.

# Applicable DEER

The existing DEER measures for LED luminaires are not applicable. There are 40 DEER measures for Commercial Indoor General Lighting with Tech Type equal to LED\_fixt.[[6]](#endnote-6) 13 of those 40 reference only HID basecase fixtures, not appropriate in the recessed troffer market. Of the remaining DEER measures, all are for measure wattages less than 26 Watts or more than 130 Watts. The larger wattage measures generally came from workpapers for High-Bay fixtures, and the lower wattage measures generally have medium screw-base lamps as their basecase. None of the DEER measures are applicable to LED fixtures replacing linear fluorescent fixtures in the 1’x4’, 2’x4’ or 2’x2’ panel sizes.

The LED Panel workpaper may reference DEER EUL/RUL values and DEER NTGR values.

# Proposed Measure Parameter Data and Sources

**Table 3.** Proposed Measure Parameter Data and Sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Parameter** | **Data** | **Source Description[[7]](#footnote-1)** | **Modification of DEER or reason for not using DEER** | **Confidence Level**  **(High, Medium, Low)** |
| Savings – kWh | <http://designlights.org/resources/file/n-e-e-p-d-l-c-q-p-l-24-xlsx> | [DesignLights Consortium](http://www.designlights.org/) and [Title 24 LPDs](http://www.energy.ca.gov/2012publications/CEC-400-2012-004/CEC-400-2012-004-CMF-REV2.pdf) | No applicable DEER measure | Medium |
| Savings – kW | See above | See above | See above | Medium |
| Savings – therm | Lighting-5-17-12-WP\_Template\_v01.xlsx | ED Lighting Interactive Effects |  | High |
| EUL or RUL | DLC-minimum 50,000 hours ÷ DEER HOU | [www.Designlights.org](http://www.Designlights.org) and DEER | No modification | High |
| MC or IMC | Fixture Pricing | Survey to be conducted of lighting distributors and manufacturers’ agents | No applicable DEER measure | High |
| NTG | DEER1314\_SupportTable\_NTG.csv | DEER | No modification | High |

# Commission Staff Review and Feedback

*Commission staff should provide feedback on proposed data and sources within 10 days of request.*

**Table 3.** Commission Staff Feedback on Proposed Data and Sources

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Parameter** | **Date Sent to Staff** | **Date Staff Responded** | **Commission Staff Comment** |
| Savings – kWh |  |  |  |
| Savings – kW |  |  |  |
| Savings – therm |  |  |  |
| EUL or RUL |  |  |  |
| MC or IMC |  |  |  |
| NTG |  |  |  |

# Cal TF Comments on Proposed Measure Parameter Data and Sources

*Cal TF comments on proposed data and sources. Do data represent best available data? If not, what are alternate data/sources that should be considered?*

**Table 5.** Cal TF Comments on Measure Parameter Data and Sources

|  |  |  |
| --- | --- | --- |
| **Measure Parameter** | **Cal TF Comments on**  **Proposed Data/Source** | **Cal TF Recommendation(s) on Alternate Sources to Consider** |
| Savings – kWh |  |  |
| Savings – kW |  |  |
| Savings – therm |  |  |
| EUL or RUL |  |  |
| MC or IMC |  |  |
| NTG |  |  |

# Proposed Measure Parameter Methodology Sources

*Include a list of all methodology and associated references that will be used for workpaper cost effectiveness parameters. Indicate level of confidence that methodology will be sufficient to develop reasonably accurate values with reasonable resource availability. Should include web links or linked/embedded files for the reviewer in Appendix A. Articulate in this section any methodology assumptions that the TF should be aware of.*

There are typical assumptions about linear fluorescent fixtures’ energy consumption that have been used in IOU programs for the decades that linear fluorescents have been the incumbent technology in commercial interior spaces, for example, the assumption that fluorescent fixtures should be assumed to use a normal light output (NLO) ballast factor. These assumptions helped standardize savings claims for linear fluorescent relamping or retrofitting, but they are less applicable for non-fluorescent measures such as LEDs than the Title 24 requirements for Luminaire Modification in Place. In the context of a change in light source technology, fixture wattages will be constrained by Title 24 Lumen Power Densities (LPDs), so those LPDs should form the basis for determining code baselines.

2 savings calculation methodologies are proposed for consideration by the Cal TF, both using T24 LPDs as a starting point:

1. Using the illumination models from the CASE Report submitted by California IOU advocates to the CEC Title 24 proceedings to define the code-compliant baseline for Luminaire Modifications-in-Place.
   * Research the assumptions that were used to justify the cost-effectiveness of the Lighting Power Densities (LPDs) when originally incorporated into Title 24
   * Use the consultant’s assumed maximum fixture wattage required to meet Title 24 as the base case for the fixture measure rebate
     + Update the LPDs from the original Title 24 analysis to the 2013 Title 24 LPD values, if the original analysis comes from an earlier T24 proceeding
2. Build a data set of actual fixture performance based on fixture photometric layouts
   * Pick a set of 5 – 10 commonly sold fixtures in California for Title 24-compliant projects, using distributor or manufacturer representative input as needed
   * Use photometric analysis software to lay out the fixtures in a sample space with fixture spacing for a typical office sector (e.g. 8’ x 10’)
   * Use Title 24 LPDs to determine which ballast and lamp configurations would meet building code
   * Use the average of the minimum code-compliant lamp and ballast configurations as the base case for the fixture measure rebate

**Table 6.** Proposed Measure Parameter Methodology and Sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Parameter** | **Methodology** | **Source Description[[8]](#footnote-2)** | **Modification of DEER or reason for not using DEER** | **Confidence Level**  **(High, Medium, Low)** |
| Savings – kWh |  | Either of 2 methodologies described above |  | Medium |
| Savings – kW |  | See above |  | Medium |
| Savings – therm |  | ED Lighting I.E. |  | High |
| EUL or RUL |  | DEER |  | High |
| MC or IMC |  | Survey |  | High |
| NTG |  | DEER |  | High |

# Cal TF Comments on Proposed Measure Parameter Methodology and Sources

*Cal TF comments on proposed methodology and sources. Do values represent best available data? If not, what are alternate methods/sources that should be considered?*

**Table 7.** Cal TF Comments on Measure Parameter Methodology and Sources

|  |  |  |
| --- | --- | --- |
| **Measure Parameter** | **Cal TF Comments on**  **Proposed Data/Source** | **Cal TF Recommendation(s) on Alternate Sources to Consider** |
| Savings – kWh |  |  |
| Savings – kW |  |  |
| Savings – therm |  |  |
| EUL or RUL |  |  |
| MC or IMC |  |  |
| NTG |  |  |

# Questions for CPUC Staff on Applicability of DEER Values, Methods, Tools, Data, Etc.

*List any questions for CPUC staff proposed data and methodology, including questions about applicable DEER values, methods, data. Question should be specific, and provide link to DEER where applicability is uncertain.*

# Additional Research Needed

*Author should list any other research needed to complete the abstract and/or workpaper.*

# Applicable EM&V

*Describe any recent EM&V studies (California or other jurisdiction) that should be considered in developing measure WP, with link to study in Appendix A.*

# Workpaper Development

Provide:

1. Proposed WP developer, and justification for why developer selected.

2. List key tasks for developer

3. Provide proposed budget for WP development.

# Appendix A – Sources

List all source links or embedded documents

1. Accessed at <http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-adoption-report_2013.pdf>, p. 34. [↑](#endnote-ref-1)
2. Eilert, P. Fernstrom, G. and E. Elliott, 2008. Codes and Standards Enhancement Initiative. For PY2008: Title 20 Standards Development. Analysis of Standards Options for Linear Fluorescent Fixtures, Preliminary CASE Report. Accessed at <http://www.energy.ca.gov/appliances/2008rulemaking/documents/2008-02-01_documents/CASE_studies/Analysis_of_Standards_Options_for_Linear_Fluorescent_Fixtures.pdf>, p. 12. [↑](#endnote-ref-2)
3. California Energy Commission website; accessed at: <http://www.energy.ca.gov/maps/maps-pdf/UTILITY_SERVICE_AREAS_DETAIL.PDF> [↑](#endnote-ref-3)
4. Accessed at <http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_energy-savings-report_jan-2012.pdf>, p. 38. [↑](#endnote-ref-4)
5. Accessed at <http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-adoption-report_2013.pdf>, p. 35. [↑](#endnote-ref-5)
6. DEER Measure List: LED\_Fixt\_MeasureDefinitions\_DEER2013.xlsx [↑](#endnote-ref-6)
7. Provide a link to source or embed source in Appendix A of this document. [↑](#footnote-ref-1)
8. Provide a link to source or embed source in Appendix A of this document. [↑](#footnote-ref-2)